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Method and System in a Communications Network

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Contents

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1 Technical Field

End-user quality of service optimisation for packet switched services in a mobile network, such as WCDMA, CDMA2000, GPRS, and WLAN.

The invention is applicable for the patent applications "Method and apparatus for network initiated rate control for P2C services in a mobile system" (PCT/SE03/00022) and "Method and apparatus for network initiated rate control for P2P services in a mobile system" (PCT/SE03/00026).

2 Technical Background

2.1 The Problem Area

The afore-mentioned two inventions enhance the QoS (Quality-of-Services) and QoE (Quality-of-end-user-Experience) for operators and end-users. However, they do not fully address how the rate control services shall be set-up in general, nor do they bring up how to deal with addressing issues in particular.

2.2 State of the Art

The need of Layer-2 triggering Rate Control (RC) mechanisms has recently been identified as an important step to providing good QoS and QoE in 2.5/3G wireless networks. Thus, Ericsson promotes such solutions for our products, as well as in the standardization (3GPP).

Since this area is new and important, certain aspects of the RC services, such as how to set them up (e.g. how to provide the Radio Network Controller (RNC)/Base Station Controller (BSC), or other types of radio network control nodes) with correct data for addressing issues), have not been fully dealt with.

3 The Invention

3.1 Summary

The main principles of the present idea are the following:

The invention identifies and solves the set-up/addressing problems for Network initiated Rate Control services, as presented in PCT/SE03/00022 and PCT/SE03/00026, for different deployment scenarios. In future scenarios, radio network control nodes such as eg. RNCs and BSCs are associated with IP addresses, whereas according to present scenarios these are un-associated with IP addresses. Moreover, the radio network control node can be pre-configured beforehand, as well as being configured with the aid of the user equipment (UE), or the application server, or the application server proxy, or the Media Gateway. Last but not least, the disclosure is divided into two main traffic scenarios, person-to-content (P2C) and person-to-person (P2P).

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3.2 Description

3.2.1 Introduction

The invention is outlined in the following way:

First we go through how the RC service is set-up and how the addressing is solved, i.e. how the source knows where to send the Rate Control (RC) messages, for different scenarios in a Person-to-Content (P2C) services context.

Therafter, we do the same for Person-to-Person (P2P) services.

3.2.2 Set-up of the RC service for P2C communication

Concerning streaming, the Rate Control service may be setup for:

1. every media stream in the SDP description. E.g., one RC service setup for the speech stream and one RC service setup for the video stream.

2. all media stream in the SDP description as a whole.

3. any combination of 1. and 2.

3.2.2.1 Pre-configuration of the radio network controlling node (RNC/BSC)

Figure 1 below outlines an architecture in which the RNC is pre-configured to manage the RC service. The receiver of the Rate Control indications is typically, but not necessarily, a Proxy. The RNC may be hard-coded or configured with data that is necessary for the service by a configuration tool. Examples of such configuration data are:

- Receiver's (Proxy's) IP address and Port number.
- The traffic class for which the RC service shall be applicable (e.g. Streaming and Interactive).
- Which users that shall have the service. This may be based on the subscription.

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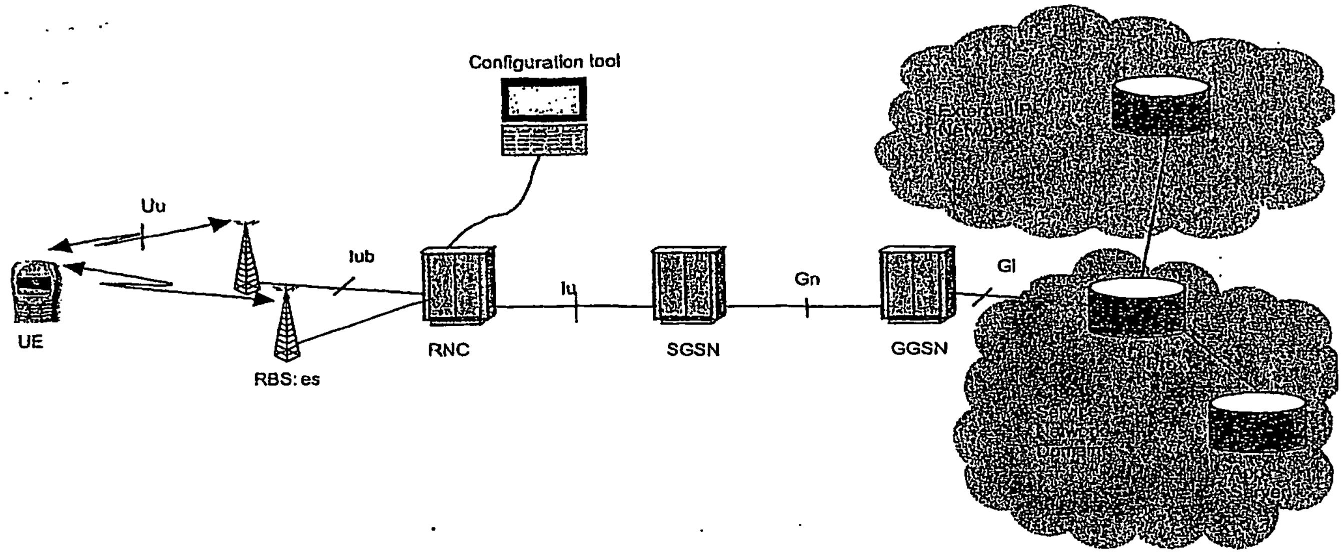

Figure 1 Architecture for Rate Control services for P2C traffic.

The below signalling diagram, Figure 2, outlines how the above described set-up procedure works for a pre-configured radio network controlling node. This procedure configures the RNC to send bandwidth (Rate Control) indications to the Proxy, via GGSN, for a specific traffic class (e.g. Streaming).

The RNC puts together an IP message and tunnels it over e.g. the GTP-U protocol via GGSN towards the Proxy. However, since the Proxy has no knowledge which session (i.e., which UE) the Rate Control message is valid for, it needs to resolve the UE's IP address and Port number. This may be done via the GTP-U Tunnel Endpoint Identifier in the T-PDU message and TFT filter mapping. (See Section 4 for explanatory notes on protocols.)

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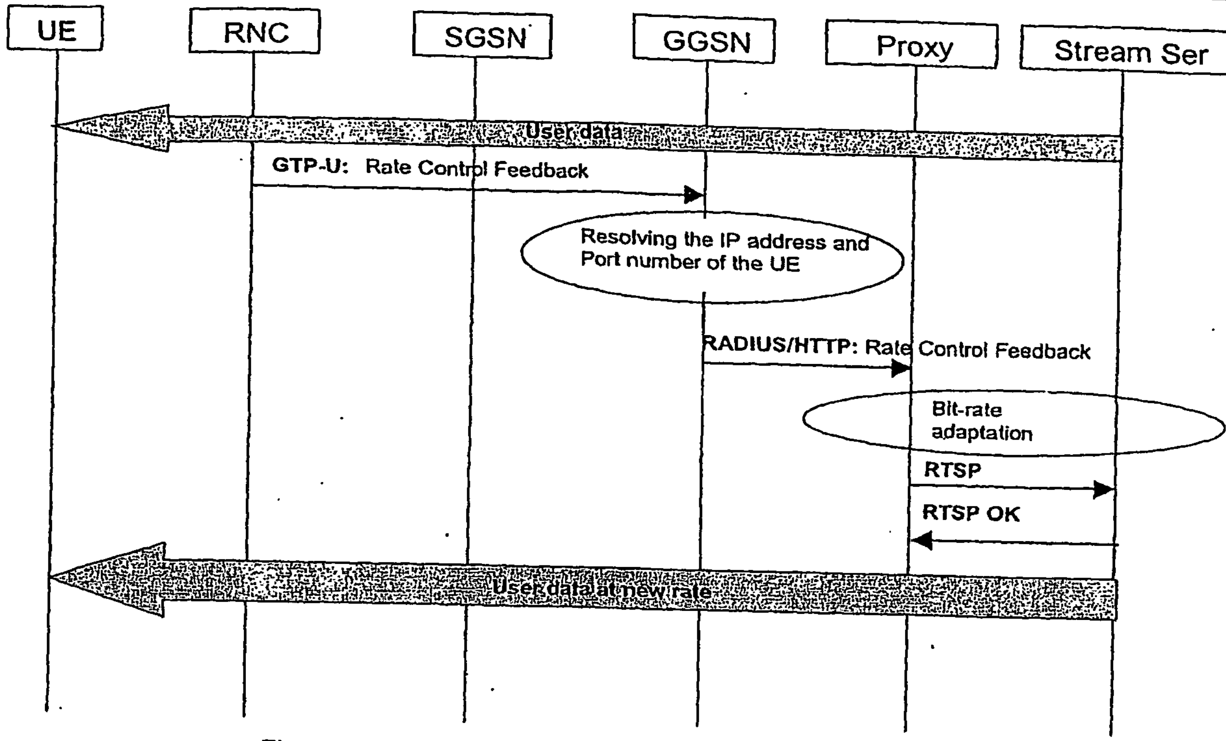

Figure 2 Example of a signalling diagram on how the addressing issue is solved when the RNC is configured to send Rate Control indications for a specific session.

When the GGSN receives the Rate Control message from the RNC, it resolves the UE's IP address and Port number, e.g. via the GTP-U Tunnel Endpoint ID (TEID) [3GPP TS 29.060] and the TFT filter parameters [3GPP TS 24.008]. Thereafter, it relays the Rate Control indication to the Proxy with the inclusion of the UE's IP address and Port number. I.e., the Rate Control message contains the new employed bandwidth over the air-interface and the source's (UE's) IP address and Port number. By including the UE's IP address and Port number, the Proxy identifies the specific application session for which the message is applicable.

3.2.2.2 The UE sets up the (RNC/BSC) upon PDP context establishment

The below figure illustrates how the UE may set-up the RNC with needed parameters for the Rate Control service. In this example we use a Proxy and a Streaming Server to illustrate the principles.

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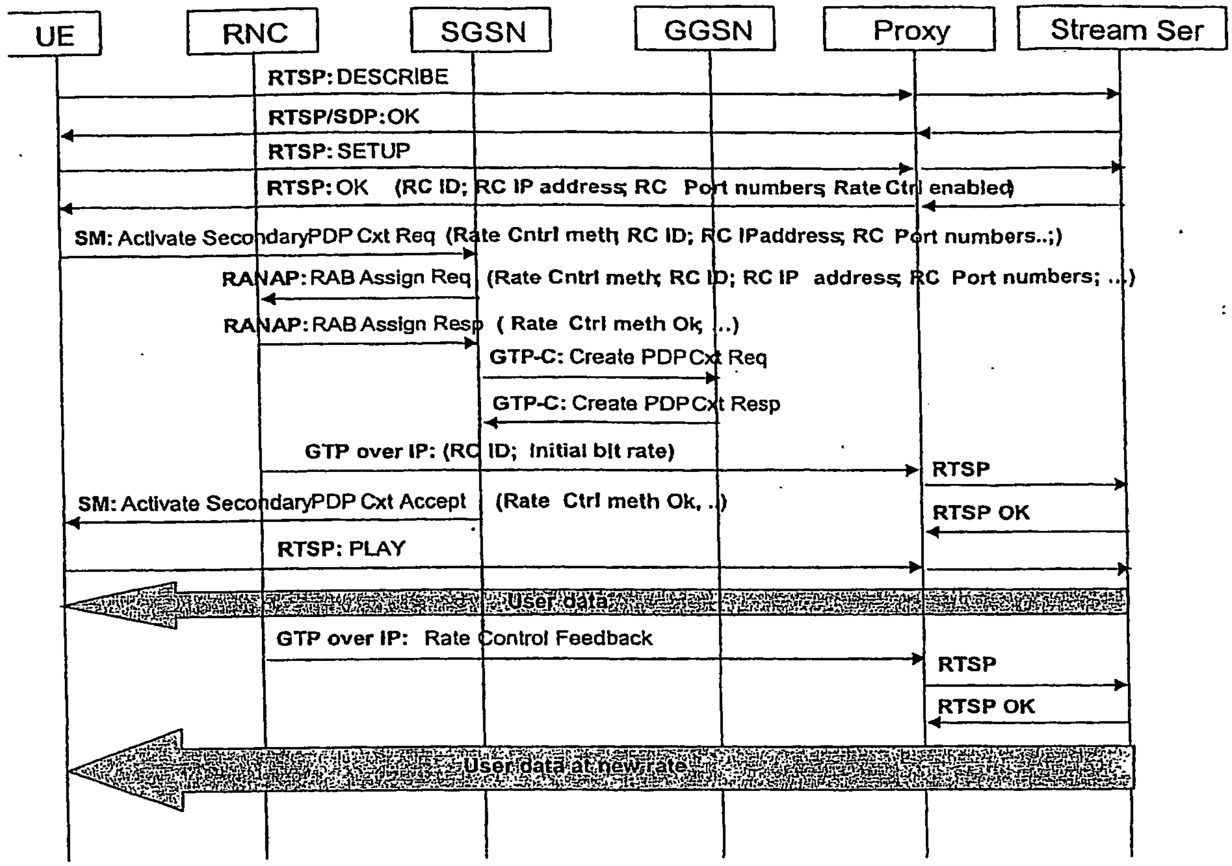

Figure 3 The UE sets up the RNC with needed parameters for the Rate Control service. In the above example, it is the Proxy that adds the specific RC parameters to the RTSP/SDP protocol. The RNC may or may not have an IP address of its own.

A specific identity (ID) has been added for the sake of RC Rate Control service. (i.e., the RC ID).

In the above example the RC IP address and RC Port number correspond to the Proxy's IP address and Port number.

Note that in presence of NATs (Network Address Translators) it is crucial that a special identity for the Rate Control service be in place in order to have the RC service working. The reason is the following: the UE IP address and Port number are operator specific (i.e., they are only locally known) and cannot be used by the Server as Rate Control service identifier.

In case of TCP based traffic the set-up parameters may e.g. be included in the HTTP header by the Proxy or the Server. Another alternative maybe more suited for general TCP traffic is to pre-configure the UE with the RC IP and Port.

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3.2.2.3 The Proxy (or the Server) sets up the (RNC/BSC) upon PDP context establishment.

The below figures 4 and 5 illustrate how the Proxy may set-up the RNC with needed parameters for the Rate Control service. In this example we use a Proxy and a Streaming Server to illustrate the principles.

In the first scenario, ie Figure 4, we assume that the RNC is not associated with an IP address. In this case the UE is totally unaware of the RC service.

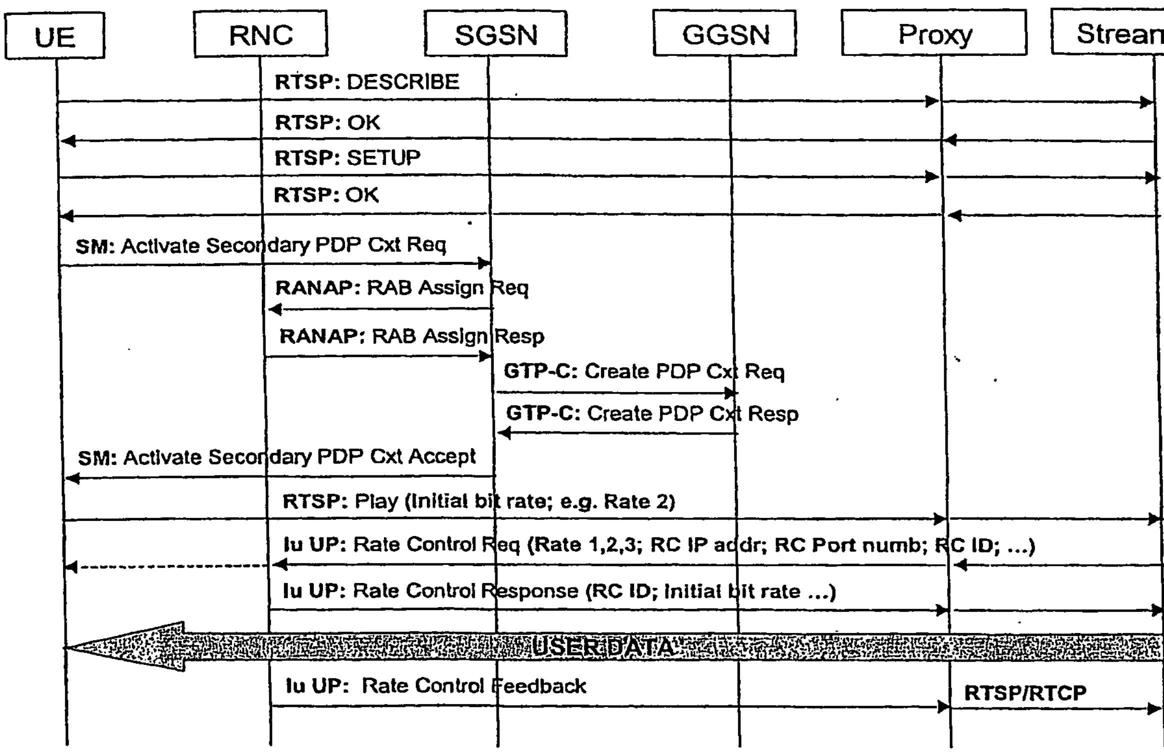

Figure 4 The Proxy sets up the RNC. The RNC has no IP addresses of its own.

This scenario requires that the RNC and the Proxy be pre-configured by means of a configuration tool with RC port number. This RC port number should be used by the Proxy as a source port number for all RC messages. The RNC uses the RC port number to single out RC messages, i.e. the messages that have source port number equal to the RC port number.

After RTSP initial signalling, the UE establishes the secondary PDP context TFT packet filters in such a way that it includes only the user data flow, as the UE is unaware of the RC service [see 3GPP TS 23.060].

The Proxy initialises the RNC. In order to perform that, the Proxy sends an Initialisation message whose IP/UDP header contains: UE IP address and user data port number as destination address and port, the source port is the RC port number (pre-configured) and source IP address is the Proxy's IP address. The message contains the following parameters:

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- RC IP address (Proxy IP address)
- RC port number (Port at which Proxy will listen to RC messages)
- RC ID.

GGSN maps the incoming initialisation message to the PDP context carrying the user data flow (i.e. the PDP context carrying the data to be controlled) since the IP address and destination port number of the RC message equal the ones of the user data.

RNC "sniffes" all the incoming traffic of that particular user and intercepts the packets that have the RC port as source port, i.e. RC messages. The RNC is able to bind the RC message with correct Radio Access Bearer (RAB) because the RC message has arrived from that particular RAB.

In UL, RNC sends the RC Response message to the RC IP address and RC port number (i.e. to the Proxy). The message contains initial bit rate and RC ID.

The Proxy uses the RC ID for binding between RC message and RTSP session.

In the second scenario (see Figure 5) it is assumed that the RNC/BSC has its own IP address and that the Proxy knows this. The Proxy may e.g. retrieve the RNC/BSC IP address from the UE upon RTSP/HTTP Session establishment phase. (We assume that the UE continuously gets updated with regard to the RNC/BSC's IP Address/Port number, for which it has established a PDP context).

In case of inter-RNC/BSC handover, the mobility management procedures ensure that the "new" RNC/BSC gets updated so that the RC service continues without any interruption.

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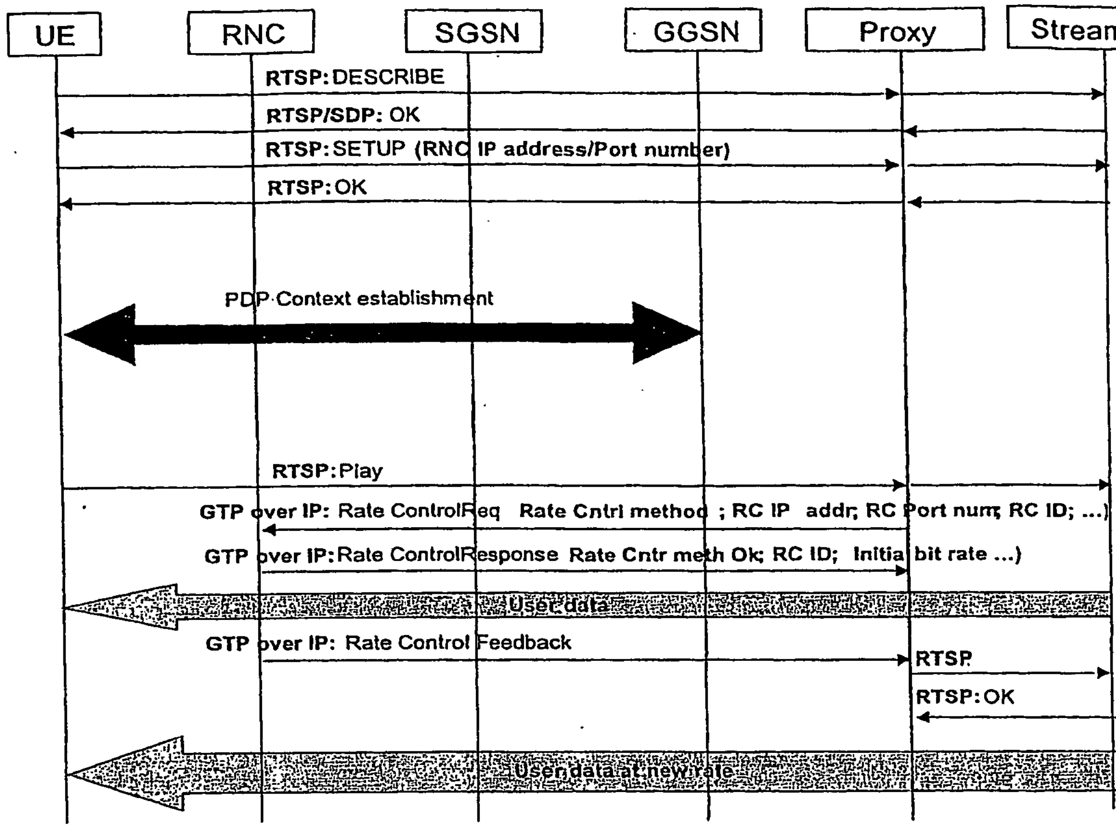

Figure 5 The Proxy sets up the RNC with needed parameters for the Rate Control service. Note that the RNC has an IP address of its own.

After initial RTSP signalling exchange and finalising of the PDP context establishment procedure, the Proxy signals specific RC parameters (RC ID, RC IP address, RC port number, UE IP address and UE data destination port number) to the RNC. The RNC has to bind the RC ID with the RAB for the session to know where to send the RC messages. In order to achieve this the RNC "sniffs" for every RAB the user data flow thereby extracting the UE IP address and UE data destination port number. This information is used to bind the RC ID with the proper RAB.

3.2.3 Set-up of the RC service for P2P communication

The general architecture for P2P services is depicted in Figure 6.

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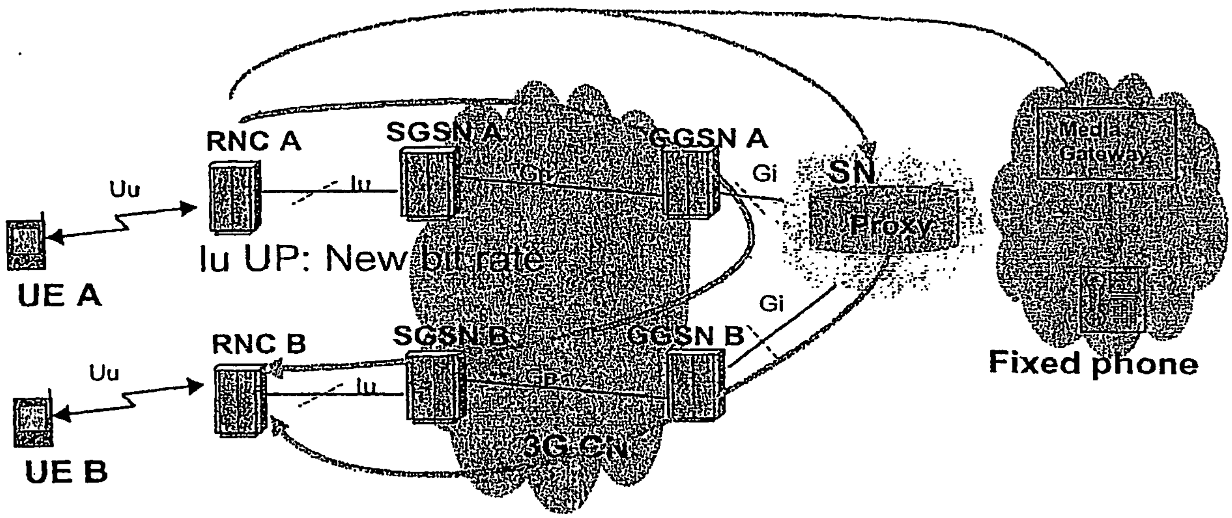

Figure 6 As can be seen from the architecture the Rate Control (RC) message may be sent from an RNC to another RNC in the mobile network or to an "equivalent" node in the fixed network (e.g. a Media Gateway). One can also see that the Rate Control messages between two UEs may traverse an intermediate node (e.g. a Proxy).

3.2.3.1 The UE sets up the RNC/BSC

The principles are the same as for P2C services. E.g., the RNC needs to be configured with equivalent parameters as in the P2C case.

In the first scenario, see Figure 7, the RNCs have no IP addresses of their own and they must therefore be set-up in a slightly different manner compared to the above case.

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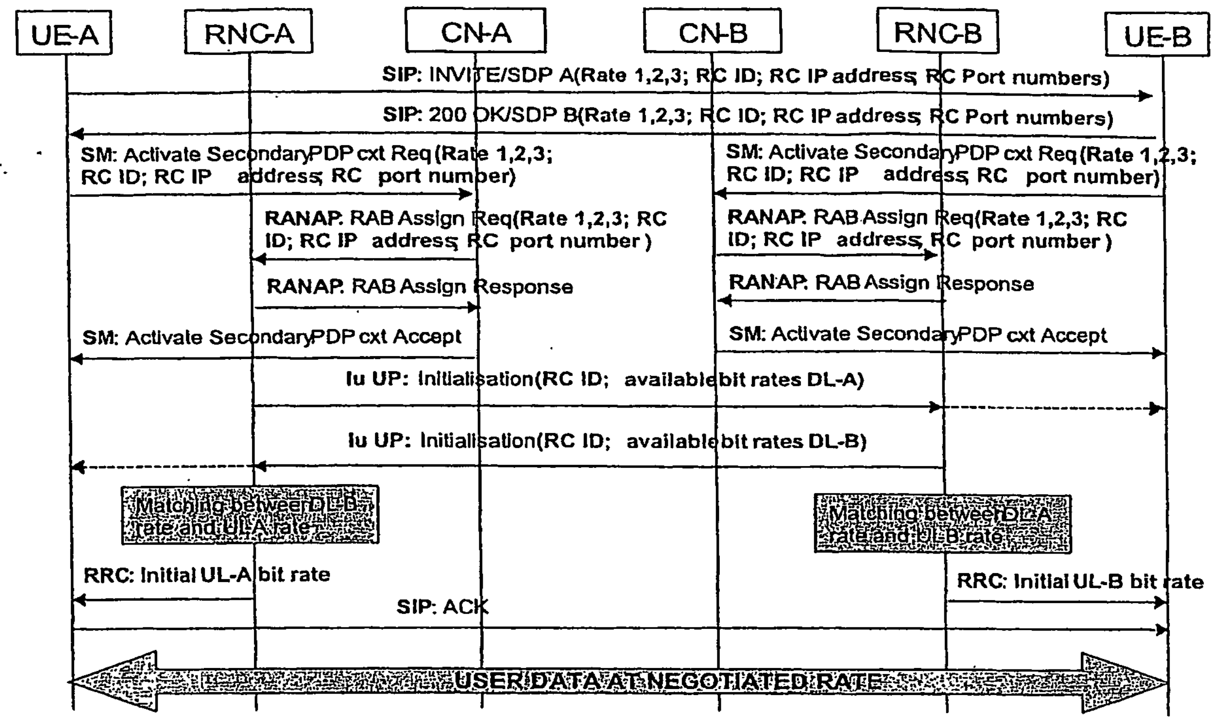

Figure 7 The Ues set up the RNC. The RNC has no IP address of its own.

The RC IP address and RC Port number correspond to the UEs IP address and Port number, respectively.

The UE-A starts by sending an INVITE message to UE-B. This message contains the SDP file, which describes the UE-A characteristics. The file contains, among other things, RC parameters (ID, IP address and Port number) and an attribute indicating that UE-A supports RC service. This attribute may be utilised by UE-B in order to indicate to RNC-B that UE-A is attached to the RAN supporting the rate control service. UE-B replies with a message containing its session description with the same information.

Once UE-A and UE-B know each other's session characteristics they start the PDP context activation procedure. The UE-A PDP context request message must contain the RC parameters of UE-B. This information is forwarded to the RNC-A by the SGSN-A by means of RANAP RAB Assignment Request message. The UE defines TFT packet filters of secondary PDP context in such a way that it includes RC messages (i.e. the incoming RC messages will be mapped onto this secondary PDP context).

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When RNC-A receives the RANAP message, containing the RC parameters, it understands that the available DL-A bit rates must be communicated to a remote entity. RNC-A uses the RC IP address (IP address of UE-B) to route the Iu UP Initialisation message towards UE-B. RNC-B uses "sniffing" technique to intercept the message as all traffic to UE-B will pass through RNC-B. "Sniffing" means that the RNC-B listens to the user data traffic from UE-A to UE-B and intercepts messages that are marked, e.g., an RC ID field in the Iu UP protocol or destination port number in IP header, to facilitate the RC service. The message contains the DL bit rates available over air interface A. RNC-B is able to bind the RC message with correct RAB because the RC message has arrived from that particular RAB.

In the second scenario, Figure 8, we assume the RNCs have their own IP addresses/port numbers and that the UE continuously gets updated with regard to the RNC/BSC's IP Address/Port number, for which it has established a PDP context.

As in the previous illustrated examples for P2C services, the RC ID is used to bind the application session with the RAB. In this scenario the RC IP address and RC Port number correspond to the respective RNC's IP address and Port number. The figure below, Figure 8, discusses the principles.

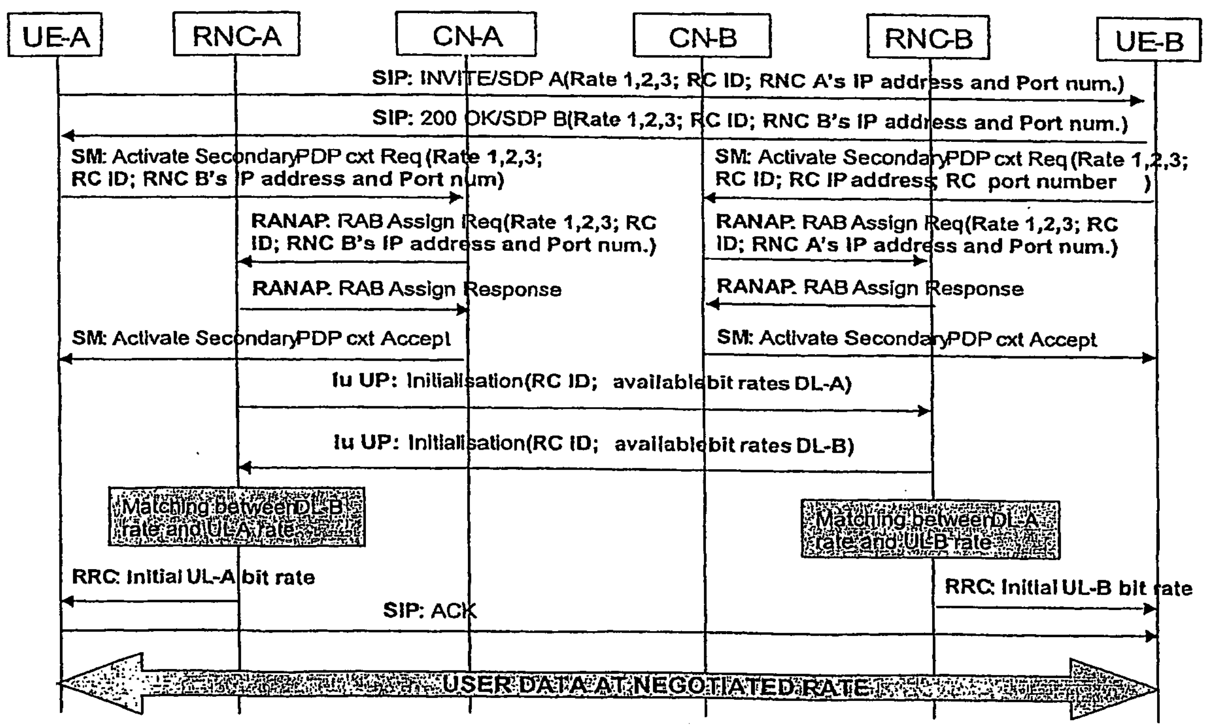

Figure 8 The Ues set-up of the RNCs to enable the Rate Control Service. Note that in the above example, the RNCs have their own IP addresses and Port numbers.

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The RNCs are set-up with the RC ID, the IP address, and Port number of the corresponding RNCs. Thereafter, the RNC-A may e.g. indicate to RNC B that it has shortage/spare radio resources in the DL, by sending a Rate Control (RC) message to RNC-B. The message contains RC ID and bit rate value. The RNC-B binds the RC message with a proper RAB basing on RC ID.

The same mechanism is used in the reverse direction (i.e. from the RNC-B to the RNC-A).

Note that if UE A moves to another controlling RNC (say, an RNC-C), the mobility management procedures ensure that the new and corresponding RNCs are updated with necessary data (e.g. new/updated RNC IP addresses/Port numbers) to continue the Rate Control service without any interruption.

3.2.3.2 The Proxy sets up the RNC/BSC

In the first scenario, Figure 9, we assume that the RNC is not associated with any IP address. In this case the UE is totally unaware about the RC service.

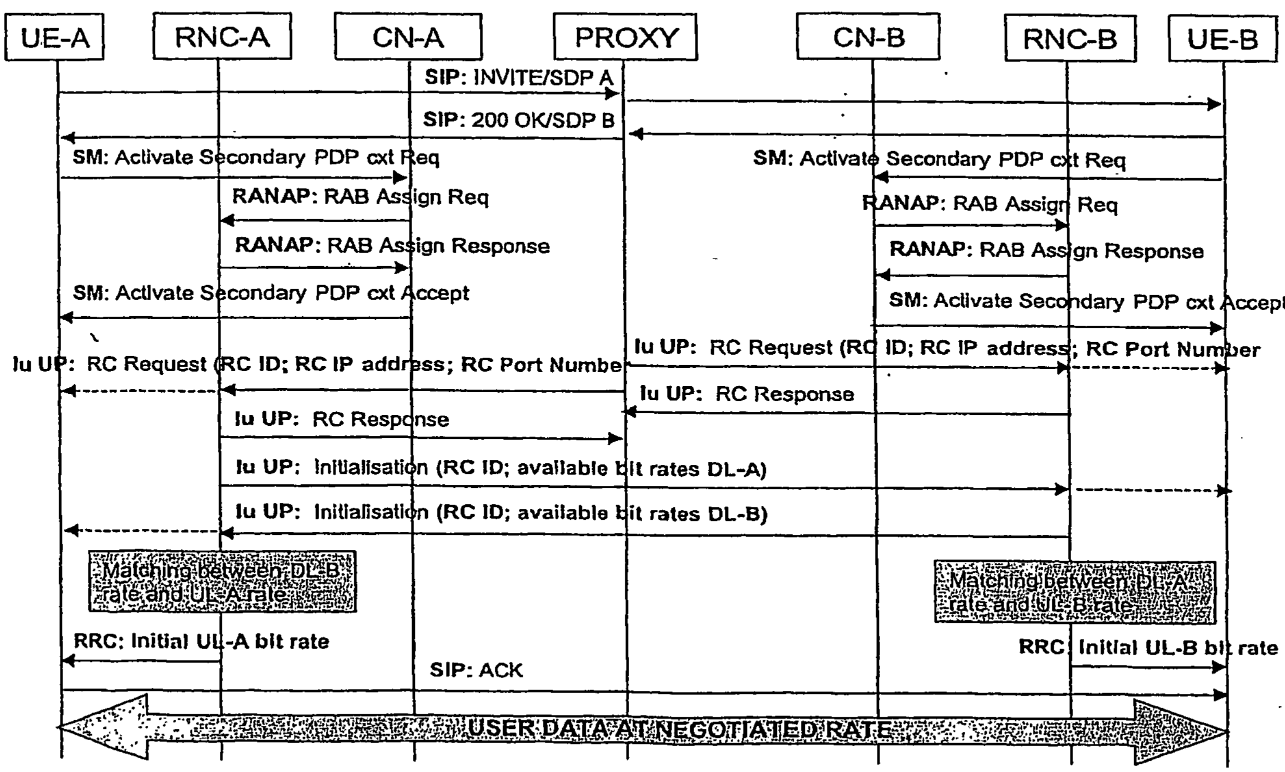

Figure 9 The SIP-Proxy(s) (the CNs must not share the same Proxy) set up the RNCs to enable the RC service. The RNCs have no IP addresses of their own.

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This scenario requires that the RNC and the Proxy be pre-configured by means of configuration tool with RC port number. This RC port number should be used by the Proxy as source port number for all RC messages. The RNC uses the RC port number to single out RC messages, i.e. the messages that have source port number equal to the RC port number.

In this scenario the Proxy is used for initialisation of RNCs only.

UE-A initiates the application session by sending an INVITE message to UE-B, via the SIP-Proxy. The message contains, among other things, the SDP file, which specifies the rates that are applicable for the session.

After initial SIP signalling, the UEs establish the secondary PDP contexts TFT packet filters in such a way that they include only the user data flow, as the UEs are unaware of the RC service [see 3GPP TS 23.060].

As the Proxy is a SIP Proxy it intercepts the SIP messages and thereby gets to know all the information about the UEs and session. Afterwards it initialises the RNCs. In order to perform that, the Proxy sends an Initialisation message to UE-A and UE-B IP destination addresses and user data port numbers as destination port; the source port is the RC port number (pre-configured) and source IP address is Proxy IP address. The message contains following parameters:

- RC IP address (peer UE IP address)
- RC source port number (Proxy could choose port at which peer RNC will listen to RC messages)
- RC ID.

GGSN maps the incoming Initialisation message to the PDP context carrying the user data flow (i.e. the PDP context carrying the data to be controlled) since the IP address and destination port number of the RC message equals the ones of the user data.

The RNCs "sniff" all the incoming traffic of that particular user and intercept the packets that have the RC port as source port, i.e. RC messages. RNCs are able to bind the RC message with correct RAB because the RC message has arrived from that particular RAB.

In UL, RNC-A sends the RC Initialisation message to the RC IP address and RC port number (i.e. to the UE-B). The message contains initial bit rate and RC ID.

GGSN-B maps the incoming initialisation message to the correct PDP context since the IP address and destination port number of RC message equals the user data flow.

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RNC-B, upon "sniffing" all the incoming traffic of that particular user, intercepts the packets that have the RC port as source port, i.e. RC messages. RNC is able to bind the RC message with correct RAB because the RC message has arrived from that particular RAB.

RNC-B replies to the Initialisation RC message in the same way as described above.

In the second scenario, see Figure 10, the RNC has its own IP address and the local SIP proxy has knowledge of it. I.e., we assume that the Proxy continuously gets updated with regard to the RNC/BSC's IP Address/Port number, for which UEs have established a PDP context. The RNC address could alternatively be received from the UE.

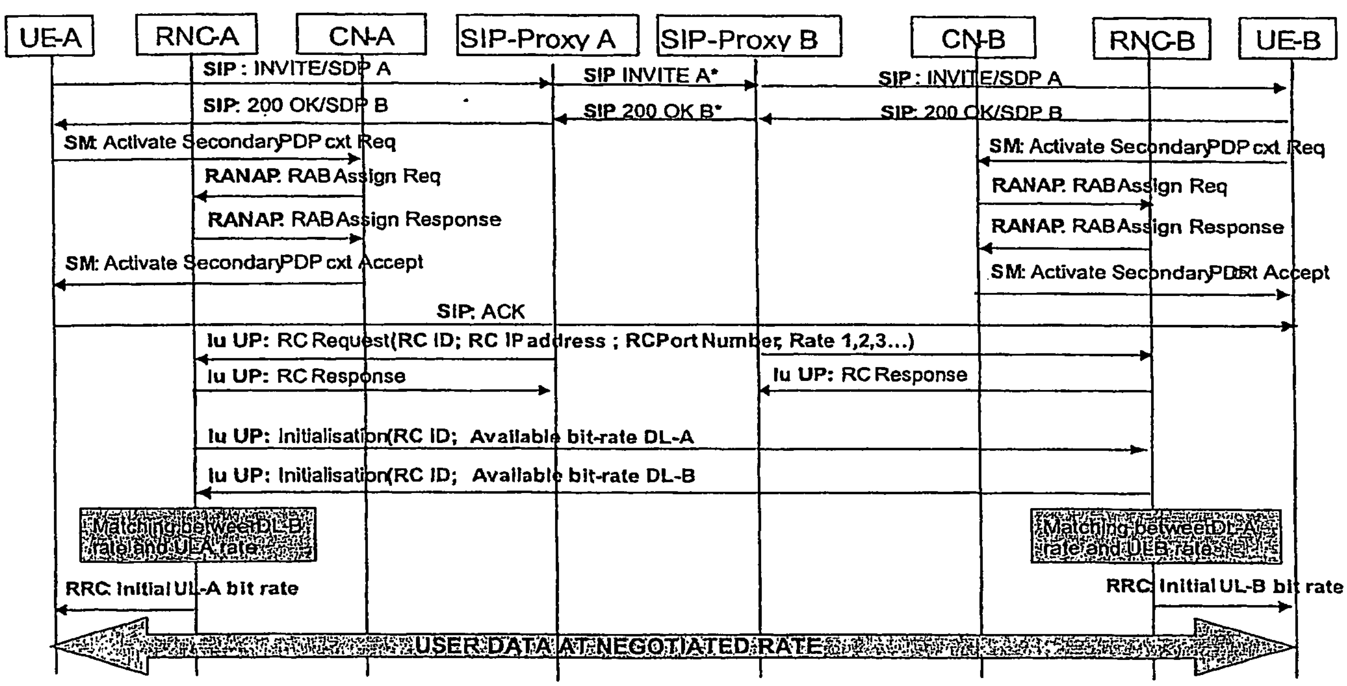

Figure 10 The SIP-Proxys set up the RNC for the RC sercvice. The RNCs have their own IP addresses.

UE-A initiates the application session by sending an INVITE message to UE-B, via the SIP-Proxy. The SIP-Proxy adds the RNC-IP address and Port number to which the UE is connected to the SIP message. The SDP file specifies the rates that are applicable for the session. If it is the UE that knows of the RNC IP, then the UE adds this information to the SIP message.

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Once UE-A and UE-B know each other's application session characteristics, they start the PDP context activation procedure. Thereafter, UE-A sends a SIP acknowledgement to UE-B, via the SIP-Proxies (one or several such proxies). The SIP-Proxies intercept this message and issue the Rate Control service by sending RC Request messages to its local RNC. These messages contain specific RC parameters (RC ID, RC IP address, RC port number, UE IP address and UE data destination port number). The RNC has to bind the RC ID with the RAB for the session to know where to send the Rate Control messages. In order to perform that RNC "sniffs" for every RAB the user data flow thereby extracting the UE IP address and UE data destination port number. This information is used to bind the RC ID with the proper RAB.

3.2.3.3 The Media Gateway sets up the RNC/BSC

In other words, this scenario is about a set-up of the RC service for mobile-to-fixed phone communication.

This P2P case can be viewed as P2C case where the Proxy is replaced by an Media Gateway (MGW). See 3.2.2.2 and 3.2.2.3.

The MGW performs transcoding functionality between PLMN and PSTN. Thus the RC service is used to properly set the transcoder's bit rate.

Case 1: The UE sets up the (RNC/BSC) upon PDP context establishment

The below figure 11 illustrates how the UE may set-up the RNC with needed parameters for the Rate Control service.

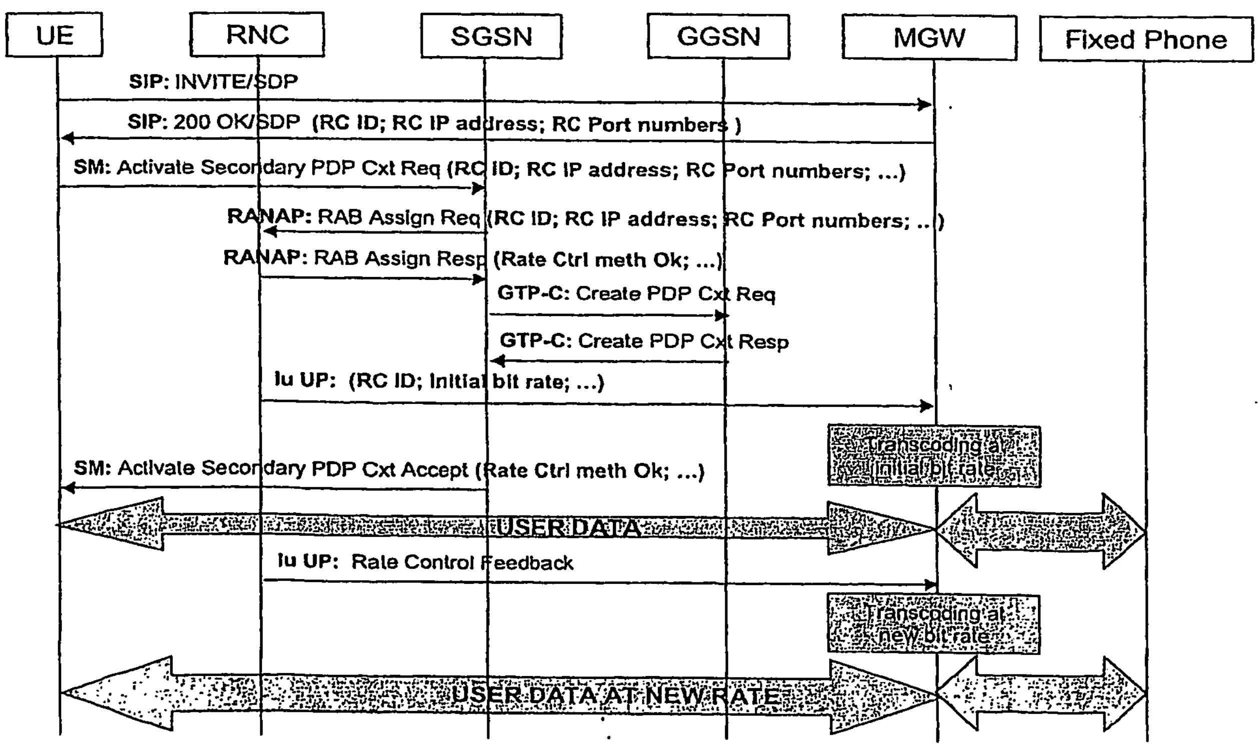

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Figure 11 The UE sets up the RNC with needed parameters for the Rate Control service. In the above example, it is the MGW that adds the specific RC parameters to the SIP/SDP protocol. The RNC may or may not have an IP address of its own.

The RC set-up in this case is quite similar to one described in section 3.2.2.2. The only difference is that the SIP protocol, instead of RTSP, is used to set up the session and thus the RC parameters are sent to the UE in the SIP OK message.

Case 2: The MGW sets up the (RNC/BSC) upon PDP context establishment

The below figures 12 and 13 illustrate how the MGW may set up the RNC with needed parameters for the Rate Control service.

In the first scenario, fig. 12, we assume that the RNC is not associated with any IP address. In this case the UE is totally unaware of the RC service.

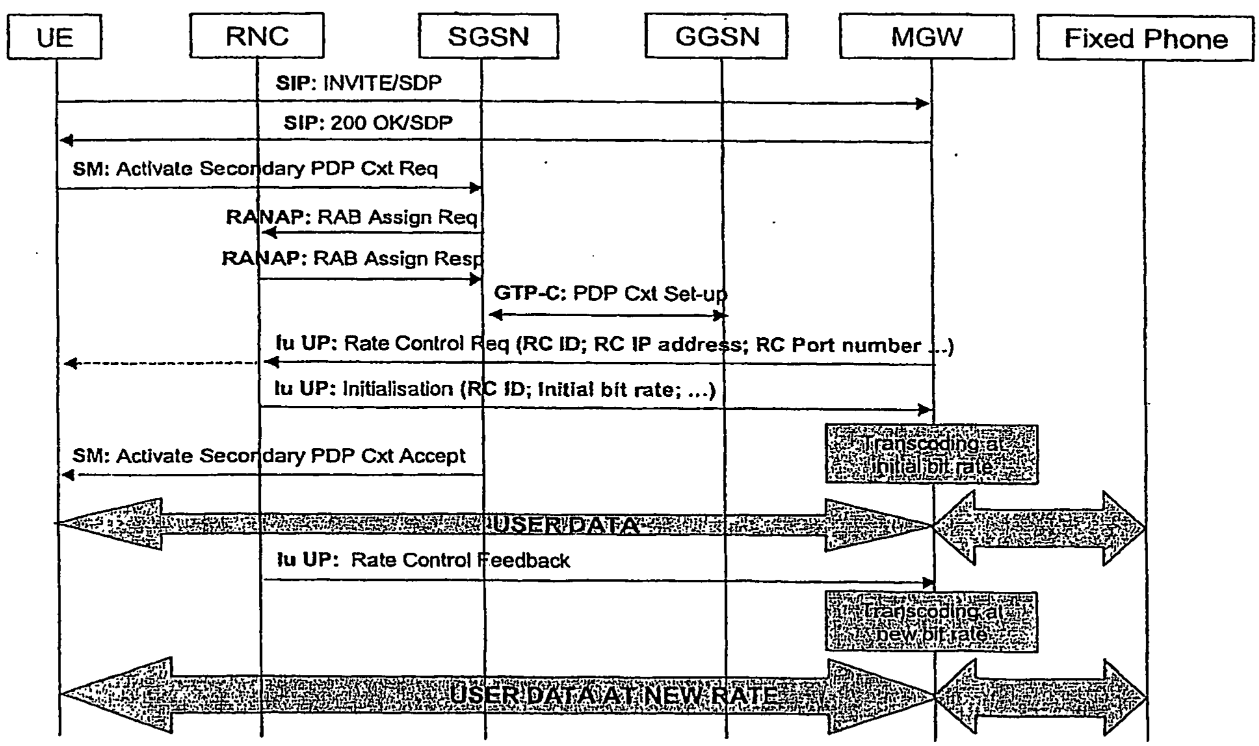

Figure 12 The MGW sets up the RNC. The RNC has no IP addresses of its own.

The RC set-up in this case is quite similar to the first scenario described in section 3.2.2.3. The only difference is that the SIP protocol, instead of RTSP, is used to set up the session.

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In the second scenario (see Fig. 13) it is assumed that the RNC/BSC has its own IP address and that the MGW knows it. The MGW may e.g. retrieve the RNC/BSC IP address from the UE upon RTSP/HTTP Session establishment phase. (We assume that the UE continuously gets updated with regard to the RNC/BSC's IP Address/Port number, for which it has established a PDP context).

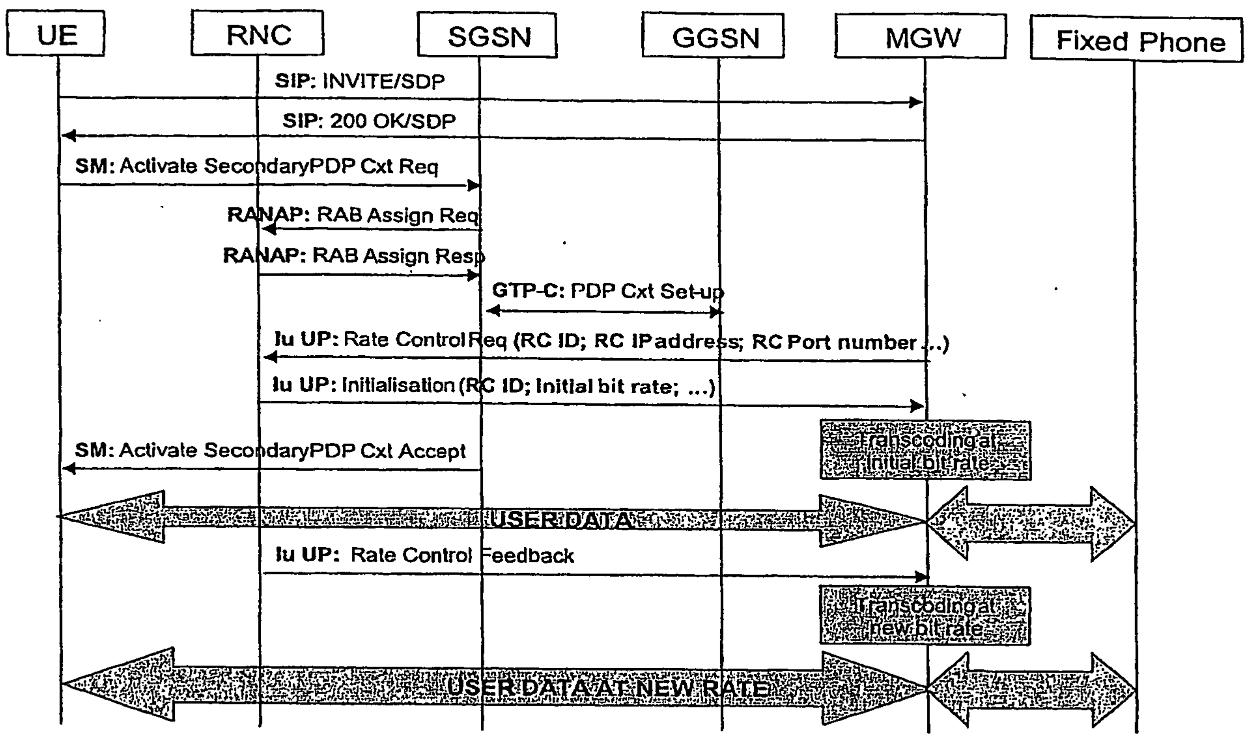

Figure 13 The MGW sets up the RNC with needed parameters for the Rate Control service. Note that the RNC has an IP address of its own.

The RC set-up in this case is quite similar to the second described in section 3.2.2.3. The only difference is that the SIP protocol, instead of RTSP, is used to set up the session.

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4 Brief Protocol Descriptions

A number of protocols are referred to throughout this disclosure. For the sake of clarity, a set of brief explanations is listed below:

RTSP

RTSP is an application-level protocol for control of the delivery of data with real-time properties. It permits to establish and control either one or several time-synchronised streams of continuous media such as audio and video. Source of data can include both live data feeds and stored clips. RTSP acts as "network remote control" for multimedia servers.

SIP

SIP is an application level protocol used to set-up P2P multimedia sessions. Initial SIP messages contain SDP object describing the session's characteristics (e.g. IP addresses, port numbers, codec types etc.)

GTP-U

GTP is a GPRS Tunnelling Protocol. It provides a tunnelling of user data and signalling between SGSN and GGSN.

In the user plane, the GTP-U protocol entity provides packet transmission and reception services to user plane entities in the GGSN, in the SGSN and, in the case of UMTS systems, in the RNC. Moreover GTP-U carries Iu UP messages.

Iu UP

The Iu UP (Iu User Plane) protocol is used to convey user data associated to Radio Access Bearers. In "support mode" Iu UP protocol may provide Radio Access Bearers (RABs) with particular features in addition to transfer of user data (e.g. Initialisation, Rate control etc.).

In general, Iu UP protocol instances exist between CN (SGSN or GGSN) and UTRAN (RNC). However, if the Iu UP protocol instances operate in support mode the Iu UP protocol instance may either be located within another UTRAN (remote RNC) or within an entity that is not the serving CN node of the UTRAN (e.g. Proxy or Media GW).

SM

The SM (Session Management) protocol provides establishment, modification and release of PDP context and controls the QoS between UE and GGSN. PDP context is stored in the UE, the SGSN, and the GGSN.

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From addressing perspective, the relevant entry in the PDP context is the Traffic Flow Template (TFT). A TFT is basically a packet filter, associating downlink packets to the correct PDP context for putting packets in the correct GTP tunnel.

RANAP

RANAP is the protocol that provides the signalling between RNC and SGSN. It is responsible for setting up, modifying, and releasing RABs.

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5 CLAIM

Method for setting up a Rate Control (RC) service in a communications network in which reside

- A) at least one mobile station (UE);
- B) an application server proxy in a Service Network domain and/or,
- C) an application server in a Service Network domain, and
- D) a Radio Network control node

the method having the purpose of enabling the proxy to send information/ /content to the mobile station (UE) on a pre-selected application session, and wherein said method comprises the following step:

- receiving high-layer parameters (configuration data such as Port number, IP address, rate control ID) in the Radio Network control node;

and the method is, moreover, also characterized by the following steps:
- tying said high-layer parameters to low-layer parameters (RAB) in the Radio Network control node;

- generating in the Radio Network control node a rate control (RC) message including the tied parameters, and

- sending the generated RC message to the application server or its proxy in the Service Network domain;

The information in the RC control message is thereafter used by the application server or its proxy to send content to the mobile station (UE) on the pre-selected application session with the right bit rate.

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